



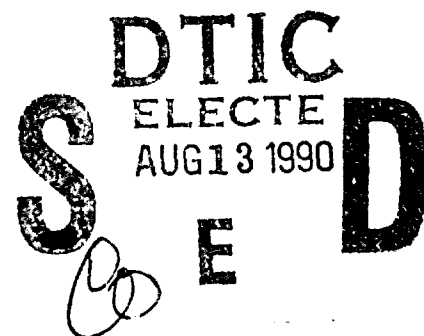
AD-A225 343

**Radio Frequency Radiation Hazard Survey
141 Tactical Control System
Ramey PR**

NOEL D. MONTGOMERY, 1Lt, USAF, BSC

May 1990

Final Report



Distribution is unlimited; approved for public release

**AF Occupational and Environmental Health Laboratory (AFSC)
Human Systems Division
Brooks Air Force Base, Texas 78235-5501**

90 08 10 32

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated, or in any way supplied the drawing, specifications, or other data, is not to be regarded by implication, or otherwise, as in any manner licensing the holder or any other person or corporation; or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The mention of trade names or commercial products in this publication is for illustration purposes and does not constitute endorsement or recommendation for use by the United States Air Force.

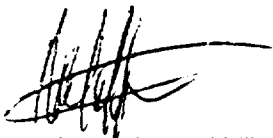
The Public Affairs Office has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nations.

This report has been reviewed and is approved for publication.

Air Force installations may direct requests for copies of this report to: Air Force Occupational and Environmental Health Laboratory (AFOEHL) Library, Brooks AFB TX 78235-5501.

Other Government agencies and their contractors registered with the DTIC should direct requests for copies of this report to: Defense Technical Information Center (DTIC), Cameron Station, Alexandria VA 22304-6145.

Non-Government agencies may purchase copies of this report from: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield VA 22161



NOEL D. MONTGOMERY, 1Lt, USAF, BSC
Consultant, Nonionizing Radiation



EDWARD F. MAHER, Lt Col, USAF, BSC
Chief, Radiation Services Division

REPORT DOCUMENTATION PAGE			Form Approved DNR No. 0704 (184)	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing existing information, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Washington Headquarters Service, Paperwork Project, (0704-0184), Washington, DC 20543-0002.</small>				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE May 1990	3. REPORT TYPE AND DATES COVERED Final 29 Mar 1990		
4. TITLE AND SUBTITLE Radio Frequency Radiation Hazard Survey, 141st Tactical Control Squadron, Ramey PR		5. FUNDING NUMBERS		
6. AUTHOR(S) NOEL D. MONTGOMERY, 1Lt, USAF, BSC				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AFOEHL/RZC Brooks AFB TX 78235-5501		8. PERFORMING ORGANIZATION REPORT NUMBER AFOEHL Report 90-088 RC00679ERA		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION AVAILABILITY STATEMENT Distribution Statement A, Unlimited		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) At the request of 156th TAC Clinic Bioenvironmental Engineer, AFOEHL personnel surveyed radio frequency radiation (RFR) hazards from the AN/TPS-43E transportable radar at the 141st Tactical Control Squadron, Ramey PR. During the survey, final installation checks were being performed on a new AN/FPS-93 radar, so a RFR hazard survey was performed on that unit as well. Measurements showed no hazard from either radar while the antennas are rotating. The AN/TPS-43E is mechanically interlocked so it will not radiate while the antenna is stopped. Operating instructions should specify immediate deactivation of the radar transmitter in case of interlock failure. The AN/FPS-93 will produce a hazard if the transmitter is operated while the antenna is stopped. The hazardous area is along the beam axis and is only accessible by persons climbing on the interior or exterior of the radome, or on the antenna structure itself. The unit Radiation Safety Officer should be notified when individuals are working on or in the radome to assure that they are not exposed to the direct beam of the radar. In the future, an AN/FPS-6 radar will be installed at the site. A theoretical evaluation is included which should be verified by direct measurement when operational. <i>ljd</i>				
14. SUBJECT TERMS Radio Frequency Radiation RFR AN/TPS-43E AN/FPS-93 AN/FPS-6			15. NUMBER OF PAGES 35	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT SAR	

(THIS PAGE LEFT BLANK)

CONTENTS

SF 298, Report Documentation Page	i
I. INTRODUCTION	1
II. BACKGROUND	2
III. SURVEY METHODS	4
IV. RESULTS	5
V. CONCLUSION AND RECOMMENDATIONS	5
APPENDIX	
A Site Map	7
B Theoretical Emitter Evaluations	11
C Measurement Results	31
Distribution List	35

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	



I. INTRODUCTION

A. Purpose:

1. The purpose of this survey was to determine radio frequency radiation (RFR) hazards from the new AN/TPS-43E radar at the 141st Tactical Control Squadron (TCS), Ramey, Puerto Rico. The survey was performed 29 Mar 90 by AFOEHL personnel at the request of MSgt Arturo Guerrero, NCOIC Bioenvironmental Engineering, 156 TAC Clinic.

2. In addition, an RFR hazard survey was performed on a new AN/FPS-93 that is currently being installed.

B. Problem:

1. The 141st TCS recently received an AN/TPS-43E search radar. Currently, the radar is mounted on a flat bed truck on the western edge of the site. The location of the radar is lower in elevation than the rest of the site, so the radar is being blanked through the 180° of azimuth that encompasses the site buildings and the two other radomes on site (see Appendix A for a site map). The AN/TPS-43E is portable and plans exist to move it to a different location on-site, or to a location several miles away.

2. A new AN/FPS-93 is being permanently installed at the 141st TCS on a tower much taller than any other structure on-site. The main concern from this radar is the hazard to personnel on the catwalk of the radar.

C. Air Force Occupational Safety and Health (AFOSH) Standard 161-9, 12 February 1987, defines the Air Force permissible exposure limit (PEL) for RFR exposure.

1. RFR is defined as electromagnetic energy emitted at frequencies from 10 kilohertz (kHz) to 300 gigahertz (GHz). The PELs are designed to limit an individual's total body absorbed dose to a specific absorption rate (SAR) of 0.4 watts per kilogram as averaged over a six minute period.

2. The PELs are dependent on radiated frequency, and the exposure location (restricted or unrestricted area). A restricted area is an Air Force workplace where only Air Force workers have access. An unrestricted area is any place where members of the general public have access. For the purpose of this survey, PELs are expressed in equivalent plane wave power density (milliwatts per squared centimeter).

3. The PELs are as follows:

Table 1: PELs for Human Exposure to RFR

Frequency in Megahertz (MHz)		PEL (mW/cm ²)	
From	To	Restricted Areas	Unrestricted Areas
0.01	3	100	100
3.0	30	900/f ² *	900/f ²
30	100	1	1
100	300	f/100	1
300	1000	f/100	f/300
1000	1500	10	f/300
1500	300,000	10	5

* Where f is the frequency in MHZ

4.2 The PELs for the AN/TPS-43E are 5 mW/cm² for unrestricted areas, and 10 mW/cm² for restricted areas. For the AN/FPS-93 the PELs are 4.3 mW/cm² for unrestricted areas and 10 mW/cm² for restricted areas.

II. BACKGROUND

A. 141 TCS Personnel Contacted:

LtCol Jorge J. Galoffin, Commander
 SMSgt Pedro Soto, Maintenance Control Supervisor
 MSgt Freddy Ortega, Radiation Protection Officer
 TSgt Wilfred Devalle, Radar Technician
 Sgt Expidito Sanchez, Radar Maintenance Technician

B. 156 TAC Clinic Personnel Contacted:

MSgt Arturo Guerrero, NCOIC, Bioenvironmental Engineering
 Sgt Caleb Principe, Bioenvironmental Engineering Technician

C. AFOEHL Survey Personnel:

1Lt Noel D. Montgomery, Nonionizing Radiation Consultant
 2Lt Daniel F. Caputo, Ionizing Radiation Consultant

D. Equipment Used:

MANUFACTURER	MODEL	DESCRIPTION	SERIAL NO	CAL DATE
NARDA	8616	Radiation Meter	02015	N/A
NARDA	8616	Radiation Meter	10081	N/A
NARDA	8696	Averaging Module	02001	N/A
NARDA	8696	Averaging Module	02003	N/A
NARDA	8621B	Broadband Probe	13031	11/89
NARDA	8621B	Broadband Probe	13008	7/89
NARDA	8623B	Broadband Probe	11006	7/89
NARDA	8623B	Broadband Probe	13152	7/89
NARDA	8611	Radiation Meter	12055	N/A

E. The AN/TPS-43E is a transportable search radar that can be operated while mounted on a flat bed truck or while mounted on a tower or rooftop. This system has two different emitters--the main search radar, and an interrogate friend or foe (IFF) system that radiates from a small antenna below the main dish. The parameters of the AN/TPS-43E are listed in Table 2 and theoretical emitter evaluations are found in Appendix B. Several options are available for permanent siting of the radar:

1. The radar can be left where it is, on the west side of the site at an elevation lower than the rest of the site. The current blanking scheme prevents any irradiation of the buildings on the site.

2. The site may be given additional land adjacent to the current site. When sited on this land, the radar would still be at an elevation lower than other structures on-site.

3. The radar could be mounted on the top of a building on site. This option would raise the radar to an elevation higher than most of the buildings on site, but the radar would still illuminate the towers of the other radars on site.

4. The radar could be moved to the Solar Observatory at a different location on the island. This site would probably be better for radar performance, but would probably not prevent illumination of surrounding structures.

Table 2: Radar Parameters

	AN/TPS-43E		AN/FPS-93	AN/FPS-6
	Main Emitter	IFF		
Operating Frequency, MHz	3000	1030	1300	2900
Peak Power, KW	4000* 2500**	2.5	2000	5000
Pulse Width, μ S	6.5	0.5	6.0	2.0
Pulse Repetition Frequency, PPS	278	525	360	400
Antenna Gain, dBi	40.6	22	35	38.5
Antenna Size, feet Width (Height)	20 (14)	10	45 (18)	8 (30)
Beamwidth, degrees Horizontal, Vertical	1.1, 8.1	7.0, 28	1.3, 5.5	3.1, 0.8

* Maximum rated output power

** Maximum operating output power and measurement conditions

F. The AN/TPS-43E is controlled from a transmitter cab that currently is positioned approximately 15 feet from the antenna. The roof of the transmitter cab is approximately 10 feet above ground level and 10 feet below the main beam axis.

G. An AN/FPS-93 and an AN/FPS-6 are currently being installed on site. During our survey, the AN/FPS-93 was operated at worst case parameters so measurements could be made. The AN/FPS-6 was not yet operational. See Table 2 for radar parameters and Appendix B for theoretical emitter evaluations for all three emitters.

III. SURVEY METHODS

A. Because the AN/TPS-43E is a transportable radar, the emphasis of this survey was to determine the radar's hazard distance independent of siting conditions. Measurements were taken with the antenna rotating using the NARDA 8696 averaging module and with the antenna stopped using direct probe measurements.

B. The antenna is mechanically interlocked to prevent emission when it is not rotating. For the purpose of our survey, the antenna interlock was physically disconnected to allow stopped beam measurements. Under operational conditions the radar would never emit when the antenna is stopped.

C. The main beam axis of the radar is 20 feet off the ground and is fixed at 0° elevation. Our stopped beam measurements were taken at points where we could reach the main beam of the radar. At other distances, the terrain prevented access, even with a 12 foot extension on our NARDA probe.

D. To allow our measurements, the blanking of the transmitter had to be overridden.

E. The maximum rated peak output power for the AN/TPS-43E is 4 megawatts (MW). However, the unit cannot be operated at peak output powers over 2.5 MW because of electrical arcing within the system. If the unit will ever be operated at a power higher than 2.5 MW, the theoretical evaluation in Appendix B can be used as a good estimation of power density.

F. The AN/FPS-93 is located on a tower that is approximately 50 feet above the ground. No existing structure on site is tall enough to allow access to the main beam. We measured levels of RFR inside the radome and on the catwalk of the radome while the antenna was rotating. Due to testing of the transmitters, the antenna could not be stopped for measurements.

G. Measurements were made around the transmitters of both radars and around all waveguides associated with each system.

IV. RESULTS

A. Measurement results are in Appendix C.

B. With the antenna rotation stopped and the blanking defeated, the measurement of the AN/TPS-43E main beam near the AN/FPS-93 tower indicates some reflection from the metal members at the base of the tower.

C. No leakage was detected from the transmitters or waveguides of either radar system.

V. CONCLUSION AND RECOMMENDATIONS

A. Based on the AFOSH Std 161-9 PELs, the AN/TPS-43E poses no RFR hazard when the antenna is rotating. If the radar is operated with the antenna rotation stopped the theoretical, main-beam hazard distances from the main emitter are 590 feet for a restricted area and 900 feet for an unrestricted area (if the emitter is operated at 4 MW the hazard distances are 790 feet for a restricted area and 1160 feet for an unrestricted area). The main beam of the radar is located at an elevation of 20 feet above the base of the flat bed truck. The transmitter could only radiate while the antenna is stopped due to a mechanical failure of the interlock system. We recommend the unit operating instructions (OIs) specify immediate deactivation of the radar transmitter in case of any mechanical failure of this interlock system.

1. Any of the possible siting configurations would be acceptable from a health hazard standpoint.

2. The current practice of blanking this radar through 180° of azimuth is unnecessary for health hazard reasons. The blanking can be removed if it is proven that doing such will not cause hazards to electroexplosive devices (EEDs) or petroleum, oils, and lubricants (POLs). The following organizations can assist with POL and EED hazard determinations:

- a. POL hazards: 1842 EEG/EEITE
Scott AFB IL 62225-5000
AUTOVON: 576-5596
- b. EED hazards: ASD/ENACE
Wright-Patterson AFB OH 45433-6503
AUTOVON: 785-7275

B. The IFF unit on the AN/TPS-43E is incapable of producing levels of RFR over the AFOSH Std PELs during either rotating or stopped operation.

C. The AN/FPS-93 radar system produces hazardous levels of RFR to a distance of 160 feet (restricted area) and 370 feet (unrestricted area) when the antenna is stopped and the radar is operating at full power. These hazardous levels of RFR are located approximately 18 feet above the catwalk of the radome and about 60 feet above ground level. When the antenna is rotating, no hazardous levels are produced by the AN/FPS-93. If any structure is erected

within 370 feet of the AN/FPS-93 tower that could allow access to the main beam of the radar, the local Bioenvironmental Engineering Service should be contacted to determine if any controls are necessary. A sign is currently posted at the entrance to the radome. Recommend that wording be added to the sign requiring notification of the Radiation Safety Officer (RSO) before entry into the radome. The RSO should ensure that the emitter is not radiating with the antenna stopped while workers are climbing on the interior or exterior of the radome or on the antenna itself.

D. Although not available for survey, a theoretical hazard analysis for the AN/FPS-6 can be found in Appendix B. Based on the AFOSH Std 161-9 PELs the AN/FPS-6 has a restricted area hazard distance of 360 feet when stopped and 80 feet when nodding. The unrestricted hazard distance is 610 feet when stopped and 130 feet when nodding. These estimations should be verified by direct measurements when the radar is operational. If the AN/FPS-6 is found to pose an RFR hazard to the operators of the AN/FPS-93, then the AN/FPS-6 should be blanked when it is directed toward the AN/FPS-93 tower. Recommend the 156 TAC Clinic Bioenvironmental Engineering Service survey the AN/FPS-6 to determine hazards to individuals on the catwalk or in the adjacent radar tower.

E. Individuals at the 141 TCS were aware of hazards associated with RFR. All employees of the site should be briefed on RFR safety and the specific safety measures required for these radar systems.

Appendix A

Site Map

(THIS PAGE LEFT BLANK)

141st TCS

← Currently Blanked Azimuths

AN/FPS-6

AN/FPS-93

AN/TFS-13E

Transmitter Cab

Site Map

(THIS PAGE LEFT BLANK)

Appendix B
Theoretical Emitter Evaluations

INTERPRETATION OF THEORETICAL MAIN BEAM POWER DENSITY ANALYSIS

The following power density estimations were generated by the AFOEHL Theoretical Main Beam Power Density Analysis Program. The power density predictions listed are generated using the far field equation and then corrected for near field conditions. The far field (uncorrected) power density predictions are valid at distances greater than the "Far Field Begins" distance in the parameter list at the beginning of the printout. At distances closer to the antenna, the near field (corrected) power density estimations are more correct. Close to the antenna, notice the power density predicted by the far field equation is much greater than the near field corrected value. At distances greater than the far field boundary, the two equations yield exactly the same value.

Theoretical Main Beam Power Density Analysis 16 APR 90
 AN/TPS-43E IFF
 AF Occupational and Environmental Health Laboratory/RZC
 Brooks AFB, Texas 78235-5501
 Autovon 240-3486 / Commercial 512-536-3486

 Transmitter

Peak Output Power (KW) 2.5000
 Pulse Width (microsec) 0.8000
 Pulse Rep Freq (Hz) 525.0000
 Duty Cycle 0.000420
 Average Power Out (KW) 0.0010
 Frequency (MHz) 1030.0000
 Wavelength (cm) 29.1261

Antenna

Aperture Type Rectangular
 Gain (dB) 22.00
 Hor,Ver Dimensions (ft) 10.00 2.00
 Hor,Ver Beamwidths (deg) 7.00 28.00
 Hor,Ver Illumination Cosine**1 Uniform

Aperture Efficiency 0.71
 Scanning Plane Horizontal
 Scanning Beamwidth (deg) 7.00
 Scanned Sector (deg) 360.00

Field Parameters

Peak ERP (MW) 0.3962
 Average ERP (MW) 0.0002
 Transition Rgn Begins (ft) 52.
 Far Field Begins (ft) 209.

 POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)

Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
1.	14.254	0.554	11.31	0.121	0.005	1.04
3.	1.584	0.062	3.77	0.101	0.004	0.95
5.	0.570	0.022	2.26	0.066	0.003	0.77
7.	0.291	0.011	1.62	0.047	0.002	0.65
9.	0.176	0.007	1.26	0.037	0.001	0.58
11.	0.118	0.005	1.03	0.029	0.001	0.51
13.	0.084	0.003	0.87	0.025	0.001	0.47
15.	0.063	0.002	0.75	0.023	0.001	0.45
17.	0.049	0.002	0.67	0.021	0.001	0.43
19.	0.039	0.002	0.60	0.019	0.001	0.42
21.	0.032	0.001	0.54	0.018	0.001	0.40
23.	0.027	0.001	0.49	0.016	0.001	0.38
25.	0.023	0.001	0.45	0.015	0.001	0.36
27.	0.020	0.001	0.42	0.013	0.001	0.35
29.	0.017	0.001	0.39	0.012	0.000	0.33

(THIS PAGE LEFT BLANK)

Theoretical Main Beam Power Density Analysis 13 APR 90
 AN/TPS-43E (OPERATING POWER)
 AF Occupational and Environmental Health Laboratory/RZC
 Brooks AFB, Texas 78235-5501
 Autovon 240-3486 / Commercial 512-536-3486

Transmitter

Peak Output Power (KW) 2500.0000
 Pulse Width (microsec) 6.5000
 Pulse Rep Freq (Hz) 278.0000
 Duty Cycle 0.001807
 Average Power Out (KW) 4.5175
 Frequency (MHz) 3000.0000
 Wavelength (cm) 10.0000

Antenna

Aperture Type Rectangular
 Gain (dB) 40.60
 Hor,Ver Dimensions (ft) 20.00 14.00
 Hor,Ver Beamwidths (deg) 1.10 8.10
 Hor,Ver Illumination Uniform Cosine**4

Aperture Efficiency 0.68
 Scanning Plane Horizontal
 Scanning Beamwidth (deg) 1.10
 Scanned Sector (deg) 360.00

Field Parameters

Peak ERP (MW) 28703.8379
 Average ERP (MW) 51.8678
 Transition Rgn Begins (ft) 610.
 Far Field Begins (ft) 2438.

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)

Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
10.	44428.164	271.505	304.45	46.614	0.285	9.86
20.	11107.041	67.876	152.23	43.238	0.264	9.50
30.	4936.463	30.167	101.48	39.760	0.243	9.11
40.	2776.760	16.969	76.11	32.642	0.199	8.25
50.	1777.127	10.860	60.89	34.911	0.213	8.53
60.	1234.116	7.542	50.74	43.889	0.268	9.57
70.	906.697	5.541	43.49	39.520	0.242	9.08
80.	694.190	4.242	38.06	23.663	0.145	7.03
90.	548.496	3.352	33.83	28.411	0.174	7.70
100.	444.282	2.715	30.45	37.385	0.228	8.83
110.	367.175	2.244	27.68	39.419	0.241	9.07
120.	308.529	1.885	25.37	35.014	0.214	8.55
130.	262.889	1.607	23.42	28.065	0.172	7.65
140.	226.674	1.385	21.75	21.457	0.131	6.69
150.	197.459	1.207	20.30	16.436	0.100	5.86

Theoretical Main Beam Power Density Analysis [cont]
AN/TPS-43E (OPERATING POWER)

POWER DENSITY (mW/cm ²) & FIELD STRENGTH (KV/M)						
Main Beam	FAR FIELD			NEAR FIELD		
Distance	***Uncorrected***			***Corrected***		
(ft)	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
160.	173.548	1.061	19.03	13.256	0.081	5.26
170.	153.731	0.939	17.91	11.653	0.071	4.93
180.	137.124	0.838	16.91	11.207	0.068	4.84
190.	123.070	0.752	16.02	11.542	0.071	4.91
200.	111.070	0.679	15.22	12.302	0.075	5.07
210.	100.744	0.616	14.50	13.260	0.081	5.26
220.	91.794	0.561	13.84	14.269	0.087	5.46
230.	83.985	0.513	13.24	15.230	0.093	5.64
240.	77.132	0.471	12.69	16.087	0.098	5.79
250.	71.085	0.434	12.18	16.811	0.103	5.92
260.	65.722	0.402	11.71	17.390	0.106	6.02
270.	60.944	0.372	11.28	17.821	0.109	6.10
280.	56.669	0.346	10.87	18.141	0.111	6.15
290.	52.828	0.323	10.50	18.332	0.112	6.18
300.	49.365	0.302	10.15	18.414	0.113	6.20
310.	46.231	0.283	9.82	18.406	0.112	6.20
320.	43.387	0.265	9.51	18.321	0.112	6.18
330.	40.797	0.249	9.23	18.174	0.111	6.16
340.	38.433	0.235	8.95	17.977	0.110	6.12
350.	36.268	0.222	8.70	17.735	0.108	6.08
360.	34.281	0.209	8.46	17.462	0.107	6.04
370.	32.453	0.198	8.23	17.162	0.105	5.98
380.	30.767	0.188	8.01	16.842	0.103	5.93
390.	29.210	0.179	7.81	16.505	0.101	5.87
400.	27.768	0.170	7.61	16.155	0.099	5.81
410.	26.430	0.162	7.43	15.794	0.097	5.74
420.	25.186	0.154	7.25	15.423	0.094	5.67
430.	24.028	0.147	7.08	15.061	0.092	5.61
440.	22.948	0.140	6.92	14.702	0.090	5.54
450.	21.940	0.134	6.77	14.342	0.088	5.47
460.	20.996	0.128	6.62	13.985	0.085	5.40
470.	20.112	0.123	6.48	13.632	0.083	5.33
480.	19.283	0.118	6.34	13.285	0.081	5.26
490.	18.504	0.113	6.21	12.946	0.079	5.20
500.	17.771	0.109	6.09	12.610	0.077	5.13
510.	17.081	0.104	5.97	12.286	0.075	5.06
520.	16.431	0.100	5.85	11.971	0.073	5.00
530.	15.816	0.097	5.74	11.663	0.071	4.93
540.	15.236	0.093	5.64	11.365	0.069	4.87
550.	14.687	0.090	5.54	11.073	0.068	4.81
560.	14.167	0.087	5.44	10.791	0.066	4.74
570.	13.674	0.084	5.34	10.516	0.064	4.68
580.	13.207	0.081	5.25	10.250	0.063	4.62
590.	12.763	0.078	5.16	9.992	0.061	4.57
600.	12.341	0.075	5.07	9.742	0.060	4.51
610.	11.940	0.073	4.99	9.500	0.058	4.45

Theoretical Main Beam Power Density Analysis [cont]
AN/TPS-43E (OPERATING POWER)

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
620.	11.558	0.071	4.91	9.265	0.057	4.40
630.	11.194	0.068	4.83	9.037	0.055	4.34
640.	10.847	0.066	4.76	8.817	0.054	4.29
650.	10.516	0.064	4.68	8.602	0.053	4.24
660.	10.199	0.062	4.61	8.395	0.051	4.18
670.	9.897	0.060	4.54	8.193	0.050	4.13
680.	9.608	0.059	4.48	7.998	0.049	4.08
690.	9.332	0.057	4.41	7.809	0.048	4.04
700.	9.067	0.055	4.35	7.626	0.047	3.99
710.	8.813	0.054	4.29	7.448	0.046	3.94
720.	8.570	0.052	4.23	7.277	0.044	3.90
730.	8.337	0.051	4.17	7.111	0.043	3.85
740.	8.113	0.050	4.11	6.950	0.042	3.81
750.	7.898	0.048	4.06	6.793	0.042	3.76
760.	7.692	0.047	4.01	6.642	0.041	3.72
770.	7.493	0.046	3.95	6.495	0.040	3.68
780.	7.302	0.045	3.90	6.353	0.039	3.64
790.	7.119	0.044	3.85	6.216	0.038	3.60
800.	6.942	0.042	3.81	6.082	0.037	3.56
810.	6.772	0.041	3.76	5.953	0.036	3.52
820.	6.607	0.040	3.71	5.827	0.036	3.49
830.	6.449	0.039	3.67	5.705	0.035	3.45
840.	6.297	0.038	3.62	5.586	0.034	3.41
850.	6.149	0.038	3.58	5.471	0.033	3.38
860.	6.007	0.037	3.54	5.358	0.033	3.34
870.	5.870	0.036	3.50	5.249	0.032	3.31
880.	5.737	0.035	3.46	5.143	0.031	3.28
890.	5.609	0.034	3.42	5.040	0.031	3.24
900.	5.485	0.034	3.38	4.941	0.030	3.21
910.	5.365	0.033	3.35	4.844	0.030	3.18
920.	5.249	0.032	3.31	4.750	0.029	3.15
930.	5.137	0.031	3.27	4.659	0.028	3.12
940.	5.028	0.031	3.24	4.571	0.028	3.09
950.	4.923	0.030	3.20	4.484	0.027	3.06
960.	4.821	0.029	3.17	4.400	0.027	3.03
970.	4.722	0.029	3.14	4.318	0.026	3.00
980.	4.626	0.028	3.11	4.238	0.026	2.97
990.	4.533	0.028	3.08	4.160	0.025	2.95
1000.	4.443	0.027	3.04	4.084	0.025	2.92
1010.	4.355	0.027	3.01	4.010	0.025	2.89
1020.	4.270	0.026	2.98	3.938	0.024	2.87
1030.	4.188	0.026	2.96	3.868	0.024	2.84
1040.	4.108	0.025	2.93	3.800	0.023	2.82
1050.	4.030	0.025	2.90	3.734	0.023	2.79
1060.	3.954	0.024	2.87	3.669	0.022	2.77
1070.	3.881	0.024	2.85	3.606	0.022	2.74

Theoretical Main Beam Power Density Analysis [cont]
AN/TPS-43E (OPERATING POWER)

POWER DENSITY (mW/cm ²) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
1080.	3.809	0.023	2.82	3.545	0.022	2.72
1090.	3.739	0.023	2.79	3.485	0.021	2.70
1100.	3.672	0.022	2.77	3.426	0.021	2.67
1110.	3.606	0.022	2.74	3.369	0.021	2.65
1120.	3.542	0.022	2.72	3.313	0.020	2.63
1130.	3.479	0.021	2.69	3.258	0.020	2.61
1140.	3.419	0.021	2.67	3.204	0.020	2.59
1150.	3.359	0.021	2.65	3.152	0.019	2.56
1160.	3.302	0.020	2.62	3.101	0.019	2.54
1170.	3.246	0.020	2.60	3.052	0.019	2.52
1180.	3.191	0.019	2.58	3.004	0.018	2.50
1190.	3.137	0.019	2.56	2.957	0.018	2.48
1200.	3.085	0.019	2.54	2.911	0.018	2.46
1210.	3.035	0.019	2.52	2.867	0.018	2.45
1220.	2.985	0.018	2.50	2.823	0.017	2.43
1230.	2.937	0.018	2.48	2.780	0.017	2.41
1240.	2.889	0.018	2.46	2.738	0.017	2.39
1250.	2.843	0.017	2.44	2.696	0.016	2.37
1260.	2.798	0.017	2.42	2.655	0.016	2.35
1270.	2.755	0.017	2.40	2.615	0.016	2.34
1280.	2.712	0.017	2.38	2.576	0.016	2.32
1290.	2.670	0.016	2.36	2.538	0.016	2.30
1300.	2.629	0.016	2.34	2.501	0.015	2.28
1310.	2.589	0.016	2.32	2.465	0.015	2.27
1320.	2.550	0.016	2.31	2.430	0.015	2.25
1330.	2.512	0.015	2.29	2.395	0.015	2.24
1340.	2.474	0.015	2.27	2.361	0.014	2.22
1350.	2.438	0.015	2.26	2.328	0.014	2.20
1360.	2.402	0.015	2.24	2.296	0.014	2.19
1370.	2.367	0.014	2.22	2.264	0.014	2.17
1380.	2.333	0.014	2.21	2.232	0.014	2.16
1390.	2.299	0.014	2.19	2.202	0.013	2.14
1400.	2.267	0.014	2.17	2.172	0.013	2.13
1410.	2.235	0.014	2.16	2.142	0.013	2.11
1420.	2.203	0.013	2.14	2.113	0.013	2.10
1430.	2.173	0.013	2.13	2.084	0.013	2.09
1440.	2.143	0.013	2.11	2.056	0.013	2.07
1450.	2.113	0.013	2.10	2.029	0.012	2.06
1460.	2.084	0.013	2.09	2.002	0.012	2.04
1470.	2.056	0.013	2.07	1.976	0.012	2.03
1480.	2.028	0.012	2.06	1.950	0.012	2.02
1490.	2.001	0.012	2.04	1.926	0.012	2.00
1500.	1.975	0.012	2.03	1.902	0.012	1.99

Theoretical Main Beam Power Density Analysis 13 APR 90
 AN/TPS-43E (FULL POWER)
 AF Occupational and Environmental Health Laboratory/RZC
 Brooks AFB, Texas 78235-5501
 Autovon 240-3486 / Commercial 512-536-3486

Transmitter

Peak Output Power (KW) 4000.0000
 Pulse Width (microsec) 6.5000
 Pulse Rep Freq (Hz) 278.0000
 Duty Cycle 0.001807
 Average Power Out (KW) 7.2280
 Frequency (MHz) 3000.0000
 Wavelength (cm) 10.0000

Antenna

Aperture Type Rectangular
 Gain (dB) 40.60
 Hor,Ver Dimensions (ft) 20.00 14.00
 Hor,Ver Beamwidths (deg) 1.10 8.10
 Hor,Ver Illumination Uniform
 Cosine**4

Aperture Efficiency 0.68
 Scanning Plane Horizontal
 Scanning Beamwidth (deg) 1.10
 Scanned Sector (deg) 360.00

Field Parameters

Peak ERP (MW) 45926.1406
 Average ERP (MW) 82.9885
 Transition Rgn Begins (ft) 610.
 Far Field Begins (ft) 2438.

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)

Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected		Peak E Field	***Corrected***		Peak E Field
	Power Density (Fixed)	Power Density (Scanning)		Power Density (Fixed)	Power Density (Scanning)	
10.	71085.063	434.409	385.11	74.583	0.456	12.47
20.	17771.266	108.602	192.55	69.181	0.423	12.01
30.	7898.341	48.268	128.37	63.617	0.389	11.52
40.	4442.816	27.151	96.28	52.228	0.319	10.44
50.	2843.403	17.376	77.02	55.857	0.341	10.80
60.	1974.585	12.067	64.18	70.223	0.429	12.10
70.	1450.716	8.865	55.02	63.232	0.386	11.49
80.	1110.704	6.788	48.14	37.861	0.231	8.89
90.	877.593	5.363	42.79	45.457	0.278	9.74
100.	710.851	4.344	38.51	59.817	0.366	11.17
110.	587.480	3.590	35.01	63.070	0.385	11.47
120.	493.646	3.017	32.09	56.023	0.342	10.81
130.	420.622	2.570	29.62	44.904	0.274	9.68
140.	362.679	2.216	27.51	34.330	0.210	8.46
150.	315.934	1.931	25.67	26.298	0.161	7.41

Theoretical Main Beam Power Density Analysis [cont]
AN/TPS-43E (FULL POWER)

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
160.	277.676	1.697	24.07	21.210	0.130	6.65
170.	245.969	1.503	22.65	18.646	0.114	6.24
180.	219.398	1.341	21.39	17.931	0.110	6.12
190.	196.912	1.203	20.27	18.468	0.113	6.21
200.	177.713	1.086	19.26	19.684	0.120	6.41
210.	161.191	0.985	18.34	21.216	0.130	6.65
220.	146.870	0.898	17.50	22.831	0.140	6.90
230.	134.376	0.821	16.74	24.367	0.149	7.13
240.	123.412	0.754	16.05	25.739	0.157	7.33
250.	113.736	0.695	15.40	26.898	0.164	7.49
260.	105.155	0.643	14.81	27.824	0.170	7.62
270.	97.510	0.596	14.26	28.514	0.174	7.71
280.	90.670	0.554	13.75	29.025	0.177	7.78
290.	84.524	0.517	13.28	29.330	0.179	7.82
300.	78.983	0.483	12.84	29.463	0.180	7.84
310.	73.970	0.452	12.42	29.449	0.180	7.84
320.	69.419	0.424	12.03	29.313	0.179	7.82
330.	65.276	0.399	11.67	29.078	0.178	7.79
340.	61.492	0.376	11.33	28.763	0.176	7.75
350.	58.029	0.355	11.00	28.377	0.173	7.69
360.	54.850	0.335	10.70	27.940	0.171	7.63
370.	51.925	0.317	10.41	27.459	0.168	7.57
380.	49.228	0.301	10.13	26.948	0.165	7.50
390.	46.736	0.286	9.87	26.408	0.161	7.42
400.	44.428	0.272	9.63	25.847	0.158	7.34
410.	42.287	0.258	9.39	25.270	0.154	7.26
420.	40.298	0.246	9.17	24.676	0.151	7.18
430.	38.445	0.235	8.96	24.098	0.147	7.09
440.	36.717	0.224	8.75	23.522	0.144	7.01
450.	35.104	0.215	8.56	22.948	0.140	6.92
460.	33.594	0.205	8.37	22.376	0.137	6.83
470.	32.180	0.197	8.19	21.811	0.133	6.75
480.	30.853	0.189	8.02	21.257	0.130	6.66
490.	29.606	0.181	7.86	20.714	0.127	6.57
500.	28.434	0.174	7.70	20.177	0.123	6.49
510.	27.330	0.167	7.55	19.658	0.120	6.40
520.	26.289	0.161	7.41	19.153	0.117	6.32
530.	25.306	0.155	7.27	18.661	0.114	6.24
540.	24.378	0.149	7.13	18.184	0.111	6.16
550.	23.499	0.144	7.00	17.717	0.108	6.08
560.	22.667	0.139	6.88	17.265	0.106	6.00
570.	21.879	0.134	6.76	16.826	0.103	5.92
580.	21.131	0.129	6.64	16.400	0.100	5.85
590.	20.421	0.125	6.53	15.988	0.098	5.78
600.	19.746	0.121	6.42	15.588	0.095	5.70
610.	19.104	0.117	6.31	15.200	0.093	5.63

Theoretical Main Beam Power Density Analysis [cont]
AN/TPS-43E (FULL POWER)

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
620.	18.492	0.113	6.21	14.824	0.091	5.56
630.	17.910	0.109	6.11	14.460	0.088	5.49
640.	17.355	0.106	6.02	14.107	0.086	5.43
650.	16.825	0.103	5.92	13.764	0.084	5.36
660.	16.319	0.100	5.83	13.432	0.082	5.29
670.	15.835	0.097	5.75	13.109	0.080	5.23
680.	15.373	0.094	5.66	12.797	0.078	5.17
690.	14.931	0.091	5.58	12.494	0.076	5.11
700.	14.507	0.089	5.50	12.201	0.075	5.05
710.	14.101	0.086	5.42	11.918	0.073	4.99
720.	13.712	0.084	5.35	11.644	0.071	4.93
730.	13.339	0.082	5.28	11.378	0.070	4.87
740.	12.981	0.079	5.20	11.120	0.068	4.82
750.	12.637	0.077	5.13	10.870	0.066	4.76
760.	12.307	0.075	5.07	10.627	0.065	4.71
770.	11.989	0.073	5.00	10.393	0.064	4.66
780.	11.684	0.071	4.94	10.165	0.062	4.61
790.	11.390	0.070	4.87	9.945	0.061	4.56
800.	11.107	0.068	4.81	9.731	0.059	4.51
810.	10.834	0.066	4.75	9.524	0.058	4.46
820.	10.572	0.065	4.70	9.323	0.057	4.41
830.	10.319	0.063	4.64	9.128	0.056	4.36
840.	10.074	0.062	4.58	8.938	0.055	4.32
850.	9.839	0.060	4.53	8.753	0.053	4.27
860.	9.611	0.059	4.48	8.573	0.052	4.23
870.	9.392	0.057	4.43	8.399	0.051	4.19
880.	9.179	0.056	4.38	8.229	0.050	4.14
890.	8.974	0.055	4.33	8.065	0.049	4.10
900.	8.776	0.054	4.28	7.905	0.048	4.06
910.	8.584	0.052	4.23	7.750	0.047	4.02
920.	8.399	0.051	4.19	7.600	0.046	3.98
930.	8.219	0.050	4.14	7.454	0.046	3.94
940.	8.045	0.049	4.10	7.313	0.045	3.91
950.	7.876	0.048	4.05	7.175	0.044	3.87
960.	7.713	0.047	4.01	7.040	0.043	3.83
970.	7.555	0.046	3.97	6.909	0.042	3.80
980.	7.402	0.045	3.93	6.780	0.041	3.76
990.	7.253	0.044	3.89	6.655	0.041	3.73
1000.	7.109	0.043	3.85	6.534	0.040	3.69
1010.	6.968	0.043	3.81	6.416	0.039	3.66
1020.	6.832	0.042	3.78	6.301	0.039	3.63
1030.	6.700	0.041	3.74	6.189	0.038	3.59
1040.	6.572	0.040	3.70	6.080	0.037	3.56
1050.	6.448	0.039	3.67	5.974	0.037	3.53
1060.	6.327	0.039	3.63	5.870	0.036	3.50
1070.	6.209	0.038	3.60	5.770	0.035	3.47

Theoretical Main Beam Power Density Analysis [cont]
AN/TPS-43E (FULL POWER)

POWER DENSITY (mW/cm ²) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
1080.	6.094	0.037	3.57	5.671	0.035	3.44
1090.	5.983	0.037	3.53	5.575	0.034	3.41
1100.	5.875	0.036	3.50	5.481	0.033	3.38
1110.	5.769	0.035	3.47	5.390	0.033	3.35
1120.	5.667	0.035	3.44	5.300	0.032	3.33
1130.	5.567	0.034	3.41	5.213	0.032	3.30
1140.	5.470	0.033	3.38	5.127	0.031	3.27
1150.	5.375	0.033	3.35	5.044	0.031	3.24
1160.	5.283	0.032	3.32	4.962	0.030	3.22
1170.	5.193	0.032	3.29	4.883	0.030	3.19
1180.	5.105	0.031	3.26	4.806	0.029	3.17
1190.	5.020	0.031	3.24	4.731	0.029	3.14
1200.	4.936	0.030	3.21	4.658	0.028	3.12
1210.	4.855	0.030	3.18	4.587	0.028	3.09
1220.	4.776	0.029	3.16	4.517	0.028	3.07
1230.	4.699	0.029	3.13	4.448	0.027	3.05
1240.	4.623	0.028	3.11	4.380	0.027	3.02
1250.	4.549	0.028	3.08	4.314	0.026	3.00
1260.	4.478	0.027	3.06	4.248	0.026	2.98
1270.	4.407	0.027	3.03	4.185	0.026	2.95
1280.	4.339	0.027	3.01	4.122	0.025	2.93
1290.	4.272	0.026	2.99	4.062	0.025	2.91
1300.	4.206	0.026	2.96	4.002	0.024	2.89
1310.	4.142	0.025	2.94	3.944	0.024	2.87
1320.	4.080	0.025	2.92	3.888	0.024	2.85
1330.	4.019	0.025	2.90	3.832	0.023	2.83
1340.	3.959	0.024	2.87	3.778	0.023	2.81
1350.	3.900	0.024	2.85	3.725	0.023	2.79
1360.	3.843	0.023	2.83	3.673	0.022	2.77
1370.	3.787	0.023	2.81	3.622	0.022	2.75
1380.	3.733	0.023	2.79	3.572	0.022	2.73
1390.	3.679	0.022	2.77	3.523	0.022	2.71
1400.	3.627	0.022	2.75	3.475	0.021	2.69
1410.	3.576	0.022	2.73	3.427	0.021	2.67
1420.	3.525	0.022	2.71	3.381	0.021	2.66
1430.	3.476	0.021	2.69	3.335	0.020	2.64
1440.	3.428	0.021	2.67	3.290	0.020	2.62
1450.	3.381	0.021	2.66	3.246	0.020	2.60
1460.	3.335	0.020	2.64	3.203	0.020	2.59
1470.	3.290	0.020	2.62	3.162	0.019	2.57
1480.	3.245	0.020	2.60	3.121	0.019	2.55
1490.	3.202	0.020	2.58	3.081	0.019	2.54
1500.	3.159	0.019	2.57	3.043	0.019	2.52

Theoretical Main Beam Power Density Analysis 13 APR 90
 AN/FPS-93
 AF Occupational and Environmental Health Laboratory/RZC
 Brooks AFB, Texas 78235-5501
 Autovon 240-3486 / Commercial 512-536-3486

 Transmitter

Peak Output Power (KW) 2000.0000
 Pulse Width (microsec) 6.0000
 Pulse Rep Freq (Hz) 360.0000
 Duty Cycle 0.002160
 Average Power Out (KW) 4.3200
 Frequency (MHz) 1300.0000
 Wavelength (cm) 23.0769

Antenna

Aperture Type Rectangular
 Gain (dB) 35.00
 Hor,Ver Dimensions (ft) 54.00 18.00
 Hor,Ver Beamwidths (deg) 1.30 5.50
 Hor,Ver Illumination Cosine**3
 Cosine**4

Aperture Efficiency 0.50
 Scanning Plane Horizontal
 Scanning Beamwidth (deg) 1.30
 Scanned Sector (deg) 360.00

Field Parameters

Peak ERP (MW) 6324.5552
 Average ERP (MW) 13.6610
 Transition Rgn Begins (ft) 1926.
 Far Field Begins (ft) 7703.

 POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)

Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
10.	11701.567	84.511	142.91	27.802	0.201	6.97
20.	2925.392	21.128	71.46	27.135	0.196	6.88
30.	1300.174	9.390	47.64	26.066	0.188	6.75
40.	731.348	5.282	35.73	24.679	0.178	6.56
50.	468.063	3.380	28.58	22.991	0.166	6.33
60.	325.044	2.348	23.82	21.147	0.153	6.08
70.	238.807	1.725	20.42	19.365	0.140	5.81
80.	182.837	1.320	17.86	17.750	0.128	5.57
90.	144.464	1.043	15.88	16.290	0.118	5.33
100.	117.016	0.845	14.29	15.019	0.108	5.12
110.	96.707	0.698	12.99	13.887	0.100	4.92
120.	81.261	0.587	11.91	12.896	0.093	4.74
130.	69.240	0.500	10.99	12.028	0.087	4.58
140.	59.702	0.431	10.21	11.260	0.081	4.43
150.	52.007	0.376	9.53	10.568	0.076	4.29

Theoretical Main Beam Power Density Analysis [cont]
AN/FPS-93

POWER DENSITY (mW/cm ²) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density		Peak E	Power Density		Peak E
	(Fixed)	(Scanning)	Field	(Fixed)	(Scanning)	Field
160.	45.709	0.330	8.93	9.953	0.072	4.17
170.	40.490	0.292	8.41	9.397	0.068	4.05
180.	36.116	0.261	7.94	8.894	0.064	3.94
190.	32.414	0.234	7.52	8.439	0.061	3.84
200.	29.254	0.211	7.15	8.028	0.058	3.74
210.	26.534	0.192	6.81	7.652	0.055	3.65
220.	24.177	0.175	6.50	7.308	0.053	3.57
230.	22.120	0.160	6.21	6.989	0.050	3.49
240.	20.315	0.147	5.95	6.694	0.048	3.42
250.	18.723	0.135	5.72	6.418	0.046	3.35
260.	17.310	0.125	5.50	6.162	0.045	3.28
270.	16.052	0.116	5.29	5.923	0.043	3.22
280.	14.925	0.108	5.10	5.701	0.041	3.15
290.	13.914	0.100	4.93	5.494	0.040	3.10
300.	13.002	0.094	4.76	5.299	0.038	3.04
310.	12.176	0.088	4.61	5.117	0.037	2.99
320.	11.427	0.083	4.47	4.947	0.036	2.94
330.	10.745	0.078	4.33	4.787	0.035	2.89
340.	10.122	0.073	4.20	4.636	0.033	2.84
350.	9.552	0.069	4.08	4.492	0.032	2.80
360.	9.029	0.065	3.97	4.355	0.031	2.76
370.	8.548	0.062	3.86	4.225	0.031	2.72
380.	8.104	0.059	3.76	4.103	0.030	2.68
390.	7.693	0.056	3.66	3.986	0.029	2.64
400.	7.313	0.053	3.57	3.873	0.028	2.60
410.	6.961	0.050	3.49	3.765	0.027	2.56
420.	6.634	0.048	3.40	3.662	0.026	2.53
430.	6.329	0.046	3.32	3.562	0.026	2.49
440.	6.044	0.044	3.25	3.466	0.025	2.46
450.	5.779	0.042	3.18	3.374	0.024	2.43
460.	5.530	0.040	3.11	3.285	0.024	2.39
470.	5.297	0.038	3.04	3.201	0.023	2.36
480.	5.079	0.037	2.98	3.118	0.023	2.33
490.	4.874	0.035	2.92	3.039	0.022	2.30
500.	4.681	0.034	2.86	2.962	0.021	2.27
510.	4.499	0.032	2.80	2.888	0.021	2.25
520.	4.328	0.031	2.75	2.816	0.020	2.22
530.	4.166	0.030	2.70	2.747	0.020	2.19
540.	4.013	0.029	2.65	2.679	0.019	2.16
550.	3.868	0.028	2.60	2.614	0.019	2.14
560.	3.731	0.027	2.55	2.551	0.018	2.11
570.	3.602	0.026	2.51	2.490	0.018	2.08
580.	3.478	0.025	2.46	2.430	0.018	2.06
590.	3.362	0.024	2.42	2.373	0.017	2.04
600.	3.250	0.023	2.38	2.317	0.017	2.01
610.	3.145	0.023	2.34	2.263	0.016	1.99

Theoretical Main Beam Power Density Analysis [cont]
AN/FPS-93

POWER DENSITY (mW/cm ²) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density		Peak E	Power Density		Peak E
	(Fixed)	(Scanning)	Field	(Fixed)	(Scanning)	Field
620.	3.044	0.022	2.31	2.211	0.016	1.96
630.	2.948	0.021	2.27	2.160	0.016	1.94
640.	2.857	0.021	2.23	2.110	0.015	1.92
650.	2.770	0.020	2.20	2.062	0.015	1.90
660.	2.686	0.019	2.17	2.016	0.015	1.88
670.	2.607	0.019	2.13	1.971	0.014	1.85
680.	2.531	0.018	2.10	1.928	0.014	1.83
690.	2.458	0.018	2.07	1.885	0.014	1.81
700.	2.388	0.017	2.04	1.844	0.013	1.79
710.	2.321	0.017	2.01	1.804	0.013	1.77
720.	2.257	0.016	1.98	1.765	0.013	1.76
730.	2.196	0.016	1.96	1.727	0.012	1.74
740.	2.137	0.015	1.93	1.691	0.012	1.72
750.	2.080	0.015	1.91	1.656	0.012	1.70
760.	2.026	0.015	1.88	1.621	0.012	1.68
770.	1.974	0.014	1.86	1.588	0.011	1.66
780.	1.923	0.014	1.83	1.556	0.011	1.65
790.	1.875	0.014	1.81	1.524	0.011	1.63
800.	1.828	0.013	1.79	1.493	0.011	1.61
810.	1.784	0.013	1.76	1.463	0.011	1.60
820.	1.740	0.013	1.74	1.433	0.010	1.58
830.	1.699	0.012	1.72	1.405	0.010	1.57
840.	1.658	0.012	1.70	1.377	0.010	1.55
850.	1.620	0.012	1.68	1.351	0.010	1.54
860.	1.582	0.011	1.66	1.325	0.010	1.52
870.	1.546	0.011	1.64	1.300	0.009	1.51
880.	1.511	0.011	1.62	1.275	0.009	1.49
890.	1.477	0.011	1.61	1.251	0.009	1.48
900.	1.445	0.010	1.59	1.227	0.009	1.46
910.	1.413	0.010	1.57	1.205	0.009	1.45
920.	1.383	0.010	1.55	1.182	0.009	1.44
930.	1.353	0.010	1.54	1.161	0.008	1.42
940.	1.324	0.010	1.52	1.139	0.008	1.41
950.	1.297	0.009	1.50	1.119	0.008	1.40
960.	1.270	0.009	1.49	1.099	0.008	1.38
970.	1.244	0.009	1.47	1.079	0.008	1.37
980.	1.218	0.009	1.46	1.060	0.008	1.36
990.	1.194	0.009	1.44	1.042	0.008	1.35
1000.	1.170	0.008	1.43	1.024	0.007	1.34

(THIS PAGE LEFT BLANK)

Theoretical Main Beam Power Density Analysis 16 APR 90
 AN/FPS-6 HEIGHT FINDER
 AF Occupational and Environmental Health Laboratory/RZC
 Brooks AFB, Texas 78235-5501
 Autovon 240-3486 / Commercial 512-536-3486

Transmitter

Peak Output Power (KW) 5000.0000
 Pulse Width (microsec) 2.0000
 Pulse Rep Freq (Hz) 400.0000
 Duty Cycle 0.000800
 Average Power Out (KW) 4.0000
 Frequency (MHz) 2900.0000
 Wavelength (cm) 10.3448

Antenna

Aperture Type Rectangular
 Gain (dB) 38.50
 Hor,Ver Dimensions (ft) 8.00 30.00
 Hor,Ver Beamwidths (deg) 3.10 0.80
 Hor,Ver Illumination Cosine**1 Cosine**2

Aperture Efficiency 0.50
 Scanning Plane Vertical
 Scanning Beamwidth (deg) 0.80
 Scanned Sector (deg) 34.00

Field Parameters

Peak ERP (MW) 35397.2852
 Average ERP (MW) 28.3178
 Transition Rgn Begins (ft) 1326.
 Far Field Begins (ft) 5304.

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)

Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
10.	24256.053	20266.293	338.09	47.752	39.898	15.00
20.	6064.013	3089.876	169.05	45.895	23.385	14.71
30.	2695.117	1097.632	112.70	50.314	20.491	15.40
40.	1516.003	532.324	84.52	52.979	18.603	15.80
50.	970.242	305.205	67.62	50.984	16.038	15.50
60.	673.779	194.336	56.35	47.240	13.625	14.92
70.	495.021	132.970	48.30	43.243	11.616	14.28
80.	379.001	95.877	42.26	39.475	9.986	13.64
90.	299.457	71.944	37.57	36.142	8.683	13.05
100.	242.561	55.705	33.81	33.205	7.626	12.51
110.	200.463	44.237	30.74	30.697	6.774	12.03
120.	168.445	35.869	28.17	28.463	6.061	11.58
130.	143.527	29.597	26.01	26.460	5.456	11.17
140.	123.755	24.786	24.15	24.710	4.949	10.79
150.	107.805	21.024	22.54	23.199	4.524	10.46

Theoretical Main Beam Power Density Analysis [cont]
AN/FPS-6 HEIGHT FINDER

POWER DENSITY (mW/cm ²) & FIELD STRENGTH (KV/M)						
Main Beam Distance	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
(ft)	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
160.	94.750	18.032	21.13	21.871	4.162	10.15
170.	83.931	15.617	19.89	20.675	3.847	9.87
180.	74.864	13.642	18.78	19.578	3.568	9.61
190.	67.191	12.008	17.79	18.563	3.318	9.35
200.	60.640	10.643	16.90	17.626	3.094	9.11
210.	55.002	9.492	16.10	16.764	2.893	8.89
220.	50.116	8.512	15.37	15.977	2.714	8.68
230.	45.853	7.673	14.70	15.261	2.554	8.48
240.	42.111	6.948	14.09	14.612	2.411	8.30
250.	38.810	6.319	13.52	14.022	2.283	8.13
260.	35.882	5.769	13.00	13.485	2.168	7.97
270.	33.273	5.286	12.52	13.001	2.065	7.83
280.	30.939	4.860	12.07	12.552	1.972	7.69
290.	28.842	4.482	11.66	12.134	1.886	7.56
300.	26.951	4.146	11.27	11.745	1.807	7.44
310.	25.240	3.845	10.91	11.379	1.733	7.32
320.	23.688	3.575	10.57	11.033	1.665	7.21
330.	22.274	3.331	10.25	10.703	1.601	7.10
340.	20.983	3.112	9.94	10.391	1.541	7.00
350.	19.801	2.912	9.66	10.088	1.484	6.90
360.	18.716	2.731	9.39	9.797	1.430	6.79
370.	17.718	2.566	9.14	9.516	1.378	6.70
380.	16.798	2.415	8.90	9.248	1.330	6.60
390.	15.947	2.277	8.67	8.996	1.285	6.51
400.	15.160	2.150	8.45	8.751	1.241	6.42
410.	14.430	2.033	8.25	8.516	1.200	6.34
420.	13.751	1.926	8.05	8.281	1.160	6.25
430.	13.118	1.826	7.86	8.055	1.121	6.16
440.	12.529	1.734	7.68	7.840	1.085	6.08
450.	11.978	1.649	7.51	7.629	1.050	6.00
460.	11.463	1.569	7.35	7.424	1.016	5.91
470.	10.981	1.495	7.19	7.224	0.984	5.83
480.	10.528	1.426	7.04	7.030	0.952	5.76
490.	10.102	1.362	6.90	6.841	0.922	5.68
500.	9.702	1.302	6.76	6.659	0.893	5.60
510.	9.326	1.245	6.63	6.482	0.866	5.53
520.	8.970	1.193	6.50	6.310	0.839	5.45
530.	8.635	1.143	6.38	6.145	0.813	5.38
540.	8.318	1.097	6.26	5.985	0.789	5.31
550.	8.019	1.053	6.15	5.831	0.765	5.24
560.	7.735	1.011	6.04	5.681	0.743	5.17
570.	7.466	0.972	5.93	5.537	0.721	5.11
580.	7.210	0.936	5.83	5.399	0.701	5.04
590.	6.968	0.901	5.73	5.264	0.681	4.98
600.	6.738	0.868	5.63	5.135	0.661	4.92
610.	6.519	0.837	5.54	5.009	0.643	4.86

Theoretical Main Beam Power Density Analysis [cont]
AN/FPS-6 HEIGHT FINDER

POWER DENSITY (mW/cm2) & FIELD STRENGTH (KV/M)						
Main Beam Distance (ft)	FAR FIELD			NEAR FIELD		
	Uncorrected			***Corrected***		
	Power Density (Fixed)	Power Density (Scanning)	Peak E Field	Power Density (Fixed)	Power Density (Scanning)	Peak E Field
620.	6.310	0.807	5.45	4.887	0.625	4.80
630.	6.111	0.779	5.37	4.769	0.608	4.74
640.	5.922	0.753	5.28	4.657	0.592	4.68
650.	5.741	0.727	5.20	4.548	0.576	4.63
660.	5.568	0.703	5.12	4.442	0.561	4.58
670.	5.403	0.681	5.05	4.338	0.546	4.52
680.	5.246	0.659	4.97	4.238	0.532	4.47
690.	5.095	0.638	4.90	4.140	0.518	4.42
700.	4.950	0.618	4.83	4.046	0.505	4.37
710.	4.812	0.599	4.76	3.954	0.492	4.32
720.	4.679	0.581	4.70	3.866	0.480	4.27
730.	4.552	0.564	4.63	3.780	0.468	4.22
740.	4.430	0.547	4.57	3.696	0.457	4.17
750.	4.312	0.532	4.51	3.615	0.446	4.13
760.	4.199	0.516	4.45	3.536	0.435	4.08
770.	4.091	0.502	4.39	3.459	0.424	4.04
780.	3.987	0.488	4.33	3.385	0.414	3.99
790.	3.887	0.475	4.28	3.312	0.404	3.95
800.	3.790	0.462	4.23	3.240	0.395	3.91
810.	3.697	0.449	4.17	3.176	0.386	3.87
820.	3.607	0.438	4.12	3.111	0.377	3.83
830.	3.521	0.426	4.07	3.047	0.369	3.79
840.	3.438	0.415	4.02	2.985	0.361	3.75
850.	3.357	0.405	3.98	2.925	0.353	3.71
860.	3.280	0.395	3.93	2.866	0.345	3.67
870.	3.205	0.385	3.89	2.808	0.337	3.64
880.	3.132	0.375	3.84	2.750	0.330	3.60
890.	3.062	0.366	3.80	2.699	0.323	3.57
900.	2.995	0.358	3.76	2.647	0.316	3.53
910.	2.929	0.349	3.72	2.596	0.309	3.50
920.	2.866	0.341	3.67	2.546	0.303	3.46
930.	2.804	0.333	3.64	2.498	0.297	3.43
940.	2.745	0.326	3.60	2.451	0.291	3.40
950.	2.688	0.318	3.56	2.405	0.285	3.37
960.	2.632	0.311	3.52	2.359	0.279	3.33
970.	2.578	0.304	3.49	2.315	0.273	3.30
980.	2.526	0.298	3.45	2.272	0.268	3.27
990.	2.475	0.291	3.42	2.230	0.262	3.24
1000.	2.425	0.285	3.38	2.190	0.257	3.21
1010.	2.378	0.279	3.35	2.150	0.252	3.18
1020.	2.331	0.273	3.31	2.112	0.247	3.15
1030.	2.286	0.267	3.28	2.075	0.243	3.13
1040.	2.243	0.262	3.25	2.039	0.238	3.10
1050.	2.200	0.257	3.22	2.004	0.234	3.07
1060.	2.159	0.251	3.19	1.970	0.229	3.05
1070.	2.119	0.246	3.16	1.937	0.225	3.02

(THIS PAGE LEFT BLANK)

Appendix C
Measurement Results

(THIS PAGE LEFT BLANK)

MEASUREMENT LOCATION	DESCRIPTION	MEASUREMENT RESULTS			MEASURED AVERAGE POWER DENSITY (milliwatts per squared centimeter)
		DISTANCE FROM ANTENNA (FEET)	HEIGHT (FEET) ABOVE GROUND		

AN/TPS-43E

Top of transmitter cab	Main beam rotating	15	20		0.8
	Main beam stopped	15	20		46.0
Bottom edge of dish	Antenna stopped				0.5
Main beam	Antenna rotating	78	16		<0.1
Main beam	Antenna stopped	30	16		23.0
		59	18		28.7
		117	18		11.5
		123	18		10.3
		144	18		9.2
		182	18		8.0
Base of adjacent antenna structure	Antenna stopped	145	18		17.3
IFF antenna	Antenna stopped	0	16		<1
Inside transmitter cab around transmitter cabinets and waveguides	Cabinets closed (interlocked)	-	-		0

AN/FSS-93

Trapdoor entrance to radome	Antenna rotating	-	-	0.2
Above catwalk in main beam	Antenna rotating	25	16 (above catwalk)	0.2
At lower edge of antenna face	Stopped beam condition*	-	-	2.0
Around waveguides		-	-	0

*If NARDA probe is illuminated for greater than 0.25 seconds it can be considered a stopped beam measurement

DISTRIBUTION LIST

	COPIES
HQ AFSC/SGP Andrews AFB DC 20334-5000	1
HQ USAF/SGPA Bolling AFB DC 20332-6188	1
7100 Combat Support Wing Med Cen/SGB APO New York 09220-5300	1
Det 1, AFOEHL APO San Francisco 96274-5000	1
USAFSAM/TSK/ED/EDH/EDZ Brooks AFB TX 78235-5301	1 (each)
HQ HSD/XA Brooks AFB TX 78235-5000	1
Defense Technical Information Center (DTIC) Cameron Station Alexandria VA 22304-6145	2
HQ AFISC/SG2R Norton AFB CA 92409-7001	1
HQ ANGSC/SGE Mail Stop 18 Andrews AFB DC 20331-6008	1
156 TAC Clinic/SGPB P.O. Box 12307 Loiza Station Muniz ANGB San Juan PR 00914-5300	1
141 TCS/CC/LGJQ P.O. Box 201 Ramey PR 00604	1 (each)